

Application No. 09/775,005
Response to Office Action

Customer No. 01933

Listing of Claims:

Claim 1 (Canceled).

2. (Currently Amended) A microscope system in which an electronic camera is used to pick up an observation image by a microscope, comprising:

5 a controlling section for setting an image pickup operation of an image pickup element in said electronic camera to an optimum state in accordance with a state of at least one of an optical system combination for a projection magnification of at least an objective lens and a photo eyepiece on a microscope side, an observation method, and lighting conditions;

10 a microscope controlling section for controlling an operation of said microscope; and

an image pickup element driving section for driving said image pickup element,

15 wherein said image pickup element driving section has a high speed reading mode for driving the image pickup element to produce an image signal by binning or thinning reading, and a low speed reading mode for driving the image pickup element to produce an image signal with a greater number of pixels than the image signal produced in the high speed reading mode;

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20 wherein said controlling section sets an image pickup element drive mode of said image pickup element driving section to ~~a~~ the high speed drive reading mode, while the controlling section detects operation information outputted from said microscope controlling section.

3. (Currently Amended) A microscope system in which an electronic camera is used to pick up an observation image by a microscope, comprising:

5 a controlling section for setting an image pickup operation of an image pickup element in said electronic camera to an optimum state in accordance with a state of at least one of an optical system combination for a projection magnification of at least an objective lens and a photo eyepiece on a microscope side, an observation method, and lighting conditions;

10 a microscope controlling section for controlling an operation of said microscope; and

an image pickup element driving section for driving said image pickup element,

15 wherein said image pickup element driving section has a binning function for driving the image pickup element to pick up the observation image in units of an image pickup unit comprising a plurality of adjacent pixels;

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20 wherein said controlling section sets a binning number,
which indicates a size of the image pickup unit, of said image
pickup element driving section based on an objective lens type
outputted from said microscope controlling section.

4. (Original) The microscope system according to claim 3,
wherein said controlling section comprises a memory in which a
table of the objective lens type and the corresponding binning
number is stored, compares the objective lens type outputted from
5 said microscope controlling section with said table to determine
the binning number, and sets the binning number as the binning
number of said image pickup element driving section.

5. (Currently Amended) The A microscope system according to
claim 3, in which an electronic camera is used to pick up an
observation image by a microscope, comprising:

5 a controlling section for setting an image pickup operation
of an image pickup element in said electronic camera to an
optimum state in accordance with a state of at least one of an
optical system combination for a projection magnification of at
least an objective lens and a photo eyepiece on a microscope
side, an observation method, and lighting conditions;
10 a microscope controlling section for controlling an
operation of said microscope; and

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an image pickup element driving section for driving said
image pickup element;

15 wherein said controlling section sets a binning number of
said image pickup element driving section based on an objective
lens type outputted from said microscope controlling section; and

wherein said controlling section comprises a memory in which
a table of the objective lens type and a corresponding NA of a
light image incident upon said electronic camera is stored,
20 compares the objective lens type outputted from said microscope
controlling section with said table to obtain the NA of the light
image incident upon said electronic camera, obtains a resolution
R of said light image from the NA, obtains the binning number as
a maximum integer of 1 or more satisfying:

25 $B < R/2p$

when the binning number is B and an element pitch of said image
pickup element is p, and sets the binning number as the binning
number of said image pickup element driving section.

6. (Previously Presented) The microscope system according
to claim 2, further comprising:

an image forming lens and an intermediate magnification
change optical system,

5 wherein said controlling section sets a binning number of
said image pickup element driving section based on an objective

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lens type, an image forming lens type and a zoom magnification of the intermediate magnification change optical system outputted from said microscope controlling section.

7. (Original) The microscope system according to claim 6, wherein said controlling section comprises a memory in which a table of the binning number corresponding to a combination of the objective lens type, the image forming lens type and the zoom magnification of the intermediate magnification change optical system is stored, compares the combination of the objective lens type, the image forming lens type and the zoom magnification of the intermediate magnification change optical system outputted from said microscope controlling section with said table to determine the binning number, and sets the binning number as the binning number of said image pickup element driving section.

8. (Currently Amended) ~~The A microscope system according to claim 6, in which an electronic camera is used to pick up an observation image by a microscope, comprising:~~

a controlling section for setting an image pickup operation of an image pickup element in said electronic camera to an optimum state in accordance with a state of at least one of an optical system combination for a projection magnification of at

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least an objective lens and a photo eyepiece on a microscope side, an observation method, and lighting conditions;

10 a microscope controlling section for controlling an operation of said microscope;

an image pickup element driving section for driving said image pickup element; and

15 an image forming lens and an intermediate magnification change optical system;

20 wherein said controlling section sets an image pickup element drive mode of said image pickup element driving section to a high speed drive mode, while the controlling section detects operation information outputted from said microscope controlling section;

25 wherein said controlling section sets a binning number of said image pickup element driving section based on an objective lens type, an image forming lens type and a zoom magnification of the intermediate magnification change optical system outputted from said microscope controlling section; and

30 wherein said controlling section comprises a memory in which a table of a combination of the objective lens type, the image forming lens type and the zoom magnification of the intermediate magnification change optical system and a corresponding NA of a light image incident upon said electronic camera is stored, compares the objective lens type, the image forming lens type and

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the zoom magnification of the intermediate magnification change optical system outputted from said microscope controlling section with said table to obtain the NA of the light image incident upon
35 said electronic camera, obtains a resolution $R (= 0.5\lambda/NA$ or $0.61\lambda/NA$: λ denoting one of wavelengths of lights constituting the light image) of said light image from the NA, obtains the binning number as a maximum integer of 1 or more satisfying:

$$B < R/2p$$

40 when the binning number is B and an element pitch of said image pickup element is p, and sets the binning number as the binning number of said image pickup element driving section.

9. (Currently Amended) ~~The A microscope system according to claim 6,~~ in which an electronic camera is used to pick up an observation image by a microscope, comprising:

5 a controlling section for setting an image pickup operation of an image pickup element in said electronic camera to an optimum state in accordance with a state of at least one of an optical system combination for a projection magnification of at least an objective lens and a photo eyepiece on a microscope side, an observation method, and lighting conditions;

10 a microscope controlling section for controlling an operation of said microscope;

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an image pickup element driving section for driving said
image pickup element; and

15 an image forming lens and an intermediate magnification
change optical system;

wherein said controlling section sets an image pickup
element drive mode of said image pickup element driving section
to a high speed drive mode, while the controlling section detects
operation information outputted from said microscope controlling
20 section;

wherein said controlling section sets a binning number of
said image pickup element driving section based on an objective
lens type, an image forming lens type and a zoom magnification of
the intermediate magnification change optical system outputted
25 from said microscope controlling section; and

wherein said controlling section;

comprises a memory in which a table of an NA and a
magnification corresponding to the objective lens type is stored,

30 compares the objective lens type outputted from said
microscope controlling section with said table to obtain the NA
of the objective lens,

obtains an image forming magnification of an optical
system of said microscope from the objective lens type, the image
forming lens type and the zoom magnification of the intermediate

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35 magnification change optical system outputted from said
microscope controlling section,

obtains the NA of a light image incident upon said
electronic camera from the NA of said objective lens and the
image forming magnification of said optical system by the

40 following equation:

$$NA = NA \text{ of the objective lens/the image forming}$$

magnification of the optical system,

obtains a resolution $R (= 0.5\lambda/NA \text{ or } 0.61\lambda/NA: \lambda$
denoting one of wavelengths of lights constituting the light
45 image) of the light image from the NA,

obtains the binning number as a maximum integer of 1 or
more satisfying:

$$B < R/2p$$

when the binning number is B and an element pitch of the image
50 pickup element is p, and

sets the binning number as the binning number of said
image pickup element driving section.

Claim 10 (Canceled).

11. (Previously Presented) The microscope system according
to claim 2, further comprising:

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an AE calculating section for performing an automatic exposure control,

5 wherein said controlling section stops an exposure time control in said AE calculating section, while the controlling section detects information of light path change of said microscope outputted from said microscope controlling section.

12. (Previously Presented) The microscope system according to claim 2, further comprising:

a frame memory for storing image data picked up by said image pickup element,

5 wherein said controlling section stops rewriting of the image data to said frame memory, while the controlling section detects information of light path change of said microscope outputted from said microscope controlling section.

13. (Previously Presented) The microscope system according to claim 2, further comprising:

a cooling section for cooling said image pickup element,

5 wherein said controlling section changes a set temperature set to said cooling section in accordance with an observation method outputted from said microscope controlling section.

Claims 14-22 (Canceled).

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23. (Currently Amended) The A microscope system according to ~~claim 14, further in which an electronic camera is used to pick up an observation image by a microscope, comprising:~~

a controlling section for setting an image pickup element in said electronic camera to an optimum state in accordance with a state of at least one of an optical system combination for a projection magnification of at least an objective lens and a photo eye piece on a microscope side, an observation method, and lighting conditions;

a microscope controlling section for controlling an operating of said microscope; and

an image adjusting section for adjusting image data picked up by said image pickup element;

wherein said controlling section comprises a memory in which
at least one color matrix in accordance with corresponding to a lighting conditions light color temperature is stored, calculates the lighting light color temperature from types and a number of filters inserted in a light path and a lighting light voltage which are output compares the lighting conditions outputted from
said microscope controlling section, compares the calculated lighting light color temperature with a content of said memory, and sets the color matrix in accordance with the lighting

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~~conditions~~ light color temperature to said image adjusting section, and

25 wherein said image adjusting section performs a color conversion of the image data in accordance with the set color matrix.

Claims 24 and 25 (Canceled).

26. (Currently Amended) ~~The~~ A microscope system according to ~~claim 25,~~ in which an electronic camera is used to pick up an observation image by a microscope, comprising:

5 a controlling section for setting recording of an image picked up by said electronic camera to an optimum state in accordance with a state of at least one of an optical system combination for a projection magnification of at least an objective lens and a photo eyepiece on a microscope side, and an observation method;

10 a microscope controlling section for controlling an operation of said microscope; and

an image recording section for recording image data picked up by said image pickup element;

15 wherein said controlling section sets a recording pixel number of an image recording section based on an objective lens type output by said microscope controlling section; and

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wherein said controlling section comprises a memory in which
a table of the objective lens type and a corresponding NA of a
light image incident upon said electronic camera, obtains a
20 resolution $R (= 0.5\lambda/NA \text{ or } 0.61\lambda/NA: \lambda \text{ denoting one of the}$
wavelengths of lights constituting the light image) of the light
image from the NA, obtains the recording pixel number as a
maximum pixel pitch satisfying:

$$Ip < R/2$$

25 when a pixel pitch of a recorded image is Ip , and sets the
recording pixel number as the recording pixel number of said
image recording section.

Claim 27 (Canceled).

28. (Currently Amended) ~~The A~~ microscope system according
to ~~claim 27~~, in which an electronic camera is used to pick up an
observation image by a microscope, comprising:

5 a controlling section for setting recording of an image
picked up by said electronic camera to an optimum state in
accordance with a state of at least one of an optical system
combination for a projection magnification of at least an
objective lens and a photo eyepiece on a microscope side, and an
observation method;

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- 10 a microscope controlling section for controlling an
operation of said microscope;
- an image recording section for recording image data picked
up by said image pickup element; and
- an image forming lens and an intermediate magnification
15 change optical system;
- wherein said controlling section sets a recording pixel
number of an image recording section based on an objective lens
type output by said microscope controlling section;
- wherein said controlling section sets a recording pixel
20 number of an image recording section based on an objective lens
type, an image forming lens type and a zoom magnification of an
intermediate magnification change optical system output by said
microscope controlling section; and
- wherein said controlling section comprises a memory in which
25 a table of a combination of the objective lens type, the image
forming lens type and the zoom magnification of the intermediate
magnification change optical system and a corresponding NA of a
light image incident upon said electronic camera is stored,
compares the objective lens type, the image forming lens type and
30 the zoom magnification of the intermediate magnification change
optical system outputted from said microscope controlling section
with said table to determine the NA of the light image incident

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upon said electronic camera, obtains a resolution $R (= 0.5\lambda/NA$ or
 $0.61\lambda/NA$: λ denoting one of the wavelengths of lights
35 constituting the light image) of the light image from the NA,
obtains the recording pixel number as a maximum pixel pitch
satisfying:

$$I_p < R/2$$

when a pixel pitch of a recorded image is I_p , and sets the
40 recording pixel number as the recording pixel number of said
image recording section.

29. (Currently Amended) ~~The A microscope system according
to claim 27, in which an electronic camera is used to pick up an
observation image by a microscope, comprising:~~

5 a controlling section for setting recording of an image
picked up by said electronic camera to an optimum state in
accordance with a state of at least one of an optical system
combination for a projection magnification of at least an
objective lens and a photo eyepiece on a microscope side, and an
observation method;

10 a microscope controlling section for controlling an
operation of said microscope;

an image recording section for recording image data picked
up by said image pickup element; and

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- an image forming lens and an intermediate magnification
15 change optical system;
- wherein said controlling section sets a recording pixel
number of an image recording section based on an objective lens
type output by said microscope controlling section;
- wherein said controlling section sets a recording pixel
20 number of an image recording section based on an objective lens
type, an image forming lens type and a zoom magnification of an
intermediate magnification change optical system output by said
microscope controlling section; and
- wherein said controlling section;
- 25 comprises a memory in which a table of an NA and a
magnification corresponding to the objective lens type is stored,
compares the objective lens type outputted from said
microscope controlling section with said table to obtain the NA
of the objective lens,
- 30 obtains an image forming magnification of an optical
system of said microscope from the objective lens type, the image
forming lens type and the zoom magnification of the intermediate
magnification change optical system outputted from said
microscope controlling section,
- 35 obtains the NA of a light image incident upon said
electronic camera from the NA of said objective lens and the

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image forming magnification of said optical system by the
following equation:

NA= NA of the objective lens/the image forming
40 magnification of the optical system,
obtains a resolution $R (= 0.5\lambda/NA \text{ or } 0.61\lambda/NA: \lambda$
denoting one of the wavelengths of lights constituting the light
image) of the light image from the NA,
obtains the recording pixel number as a maximum pixel
45 pitch satisfying:

$$Ip < R/2$$

when a pixel pitch of a recorded image is Ip , and

sets the recording pixel number as the recording pixel
number of said image recording section.

Claims 30-32 (Canceled)

33. (Previously Presented) The microscope system according
to claim 3, further comprising:

an image forming lens and an intermediate magnification
change optical system,

5 wherein said controlling section sets a binning number of
said image pickup element driving section based on an objective
lens type, an image forming lens type and a zoom magnification of

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the intermediate magnification change optical system outputted from said microscope controlling section.

34. (Previously Presented) The microscope system according to claim 33, wherein said controlling section comprises a memory in which a table of the binning number corresponding to a combination of the objective lens type, the image forming lens type and the zoom magnification of the intermediate magnification change optical system is stored, compares the combination of the objective lens type, the image forming lens type and the zoom magnification of the intermediate magnification change optical system outputted from said microscope controlling section with said table to determine the binning number, and sets the binning number as the binning number of said image pickup element driving section.

35. (Currently Amended) ~~The A~~ A microscope system according to claim 33, in which an electronic camera is used to pick up an observation image by a microscope, comprising:

a controlling section for setting an image pickup operation of an image pickup element in said electronic camera to an optimum state in accordance with a state of at least one of an optical system combination for a projection magnification of at

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least an objective lens and a photo eyepiece on a microscope side, an observation method, and lighting conditions;

10 a microscope controlling section for controlling an operation of said microscope;

an image pickup element driving section for driving said image pickup element; and

15 an image forming lens and an intermediate magnification change optical system;

wherein said controlling section sets a binning number of said image pickup element driving section based on an objective lens type outputted from said microscope controlling section;

20 wherein said controlling section sets a binning number of said image pickup element driving section based on an objective lens type, an image forming lens type and a zoom magnification of the intermediate magnification change optical system outputted from said microscope controlling section; and

25 wherein said controlling section comprises a memory in which a table of a combination of the objective lens type, the image forming lens type and the zoom magnification of the intermediate magnification change optical system and a corresponding NA of a light image incident upon said electronic camera is stored, compares the objective lens type, the image forming lens type and
30 the zoom magnification of the intermediate magnification change optical system outputted from said microscope controlling section

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with said table to obtain the NA of the light image incident upon
said electronic camera, obtains a resolution $R (= 0.5\lambda/NA$ or
 $0.61\lambda/NA$: λ denoting one of wavelengths of lights constituting
35 the light image) of said light image from the NA, obtains the
binning number as a maximum integer of 1 or more satisfying:

$$B < R/2p$$

when the binning number is B and an element pitch of said image
pickup element is p, and sets the binning number as the binning
40 number of said image pickup element driving section.

36. (Currently Amended) ~~The A~~ microscope system according
~~to claim 33, in which an electronic camera is used to pick up an~~
~~observation image by a microscope, comprising:~~

a controlling section for setting an image pickup operation
5 of an image pickup element in said electronic camera to an
optimum state in accordance with a state of at least one of an
optical system combination for a projection magnification of at
least an objective lens and a photo eyepiece on a microscope
side, an observation method, and lighting conditions;

10 a microscope controlling section for controlling an
operation of said microscope;

an image pickup element driving section for driving said
image pickup element; and

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- 15 an image forming lens and an intermediate magnification
 change optical system;
- wherein said controlling section sets a binning number of
 said image pickup element driving section based on an objective
 lens type outputted from said microscope controlling section;
- 20 wherein said controlling section sets a binning number of
 said image pickup element driving section based on an objective
 lens type, an image forming lens type and a zoom magnification of
 the intermediate magnification change optical system outputted
 from said microscope controlling section; and
- wherein said controlling section:
- 25 comprises a memory in which a table of an NA and a
 magnification corresponding to the objective lens type is stored,
 compares the objective lens type outputted from said
 microscope controlling section with said table to obtain the NA
 of the objective lens,
- 30 obtains an image forming magnification of an optical
 system of said microscope from the objective lens type, the image
 forming lens type and the zoom magnification of the intermediate
 magnification change optical system outputted from said
 microscope controlling section,
- 35 obtains the NA of a light image incident upon said
 electronic camera from the NA of said objective lens and the

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image forming magnification of said optical system by the
following equation:

NA = NA of the objective lens/the image forming
40 magnification of the optical system,
obtains a resolution $R (= 0.5\lambda/NA \text{ or } 0.61\lambda/NA: \lambda$
denoting one of wavelengths of lights constituting the light
image) of the light image from the NA,
obtains the binning number as a maximum integer of 1 or
45 more satisfying:

$$B < R/2p$$

when the binning number is B and an element pitch of the image
pickup element is p, and

sets the binning number as the binning number of said
50 image pickup element driving section.

37. (Previously Presented) The microscope system according
to claim 3, further comprising:

an AE calculating section for performing an automatic
exposure control,

5 wherein said controlling section stops an exposure time
control in said AE calculating section, while the controlling
section detects information of light path change of said
microscope outputted from said microscope controlling section.

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38. (Previously Presented) The microscope system according to claim 3, further comprising:

5 a frame memory for storing image data picked up by said image pickup element,

wherein said controlling section stops rewriting of the image data to said frame memory, while the controlling section detects information of light path change of said microscope outputted from said microscope controlling section.

39. (Previously Presented) The microscope system according to claim 3, further comprising:

5 a cooling section for cooling said image pickup element, wherein said controlling section changes a set temperature set to said cooling section in accordance with an observation method outputted from said microscope controlling section.

40. (New) The microscope system according to claim 2, further comprising:

5 a preprocessor for converting the image signal from the image pickup element into digital image data;
a frame memory for storing the digital image data which has been converted in the preprocessor; and

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an AE calculator for carrying out automatic exposure control
based on the image data stored in the frame memory;

wherein the AE calculator stops exposure time control while
10 conversion information of a light path of the microscope
outputted from the microscope controlling section is detected.

41. (New) The microscope system according to claim 3,
further comprising:

a preprocessor for converting the image signal from the
image pickup element into digital image data;

5 a frame memory for storing the digital image data which has
been converted in the preprocessor; and

an AE calculator for carrying out automatic exposure control
based on the image data stored in the frame memory;

wherein the AE calculator stops exposure time control while
10 conversion information of a light path of the microscope
outputted from the microscope controlling section is detected.